

WHAT IS CLAIMED IS:

1. A unitary polymer substrate comprising a napped surface having a plurality of frayed-end microfibers.
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2. The polymer substrate of claim 1 wherein the substrate is a fiber having an average minimum cross-sectional dimension of at least about 0.1 mm.
3. The polymer substrate of claim 1 wherein the microfibers have an
10 average length of no more than about 500 microns.
4. The polymer substrate of claim 3 wherein the microfibers have an average maximum cross sectional dimension of no more than about 60 microns.
- 15 5. The polymer substrate of claim 1 wherein the microfibers include a surface having a plurality of microfibrils.
6. The polymer substrate of claim 5 wherein microfibrils have a length of no more than about 30 microns and a maximum cross sectional dimension of no
20 more than about 10 microns.
7. The polymer substrate of claim 4 wherein the microfibrils have frayed ends.
- 25 8. The polymer substrate of claim 1 formed from a thermoplastic polymer.
9. The polymer substrate of claim 1 wherein the napped surface further comprises a plurality of projections having smooth sides and a top which include a
30 plurality of the microfibers.

10. The polymer substrate of claim 9 wherein the projections are ridges.
11. A method of producing a unitary polymer substrate including a napped surface which comprises a plurality of frayed-end microfibers, the method
5 comprising:
reciprocatingly contacting a surface of a thermoplastic polymer substrate with an abrasive surface.
12. The method of claim 11 comprising reciprocatingly contacting the
10 thermoplastic polymer surface with an abrasive surface having a grit of about 40 to about 500.
13. The method of claim 11 comprising reciprocatingly contacting the
15 abrasive surface with a thermoplastic polymer surface including a plurality of microprotrusions.
14. The method of claim 11 comprising reciprocatingly contacting the
abrasive surface with a unitary thermoplastic polymer surface which includes
projections having sides and a top, such that the abrasive surface only contacts the
20 tops of the projections.
15. The method of claim 11 comprising reciprocatingly contracting the
thermoplastic polymer surface with a first abrasive surface having a coarse grit to
form a first napped surface having a plurality of first frayed-end microfibers
25 projecting therefrom; and reciprocatingly contacting the first napped surface with a
second abrasive surface having a finer grit than the first abrasive surface to form a
second napped surface having a plurality of second projecting frayed-end
microfibers which include a surface with a plurality of microfibrils extending
therefrom.

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16. A unitary polymer substrate comprising a napped surface, the napped surface including a plurality of microfibers having an expanded cross-section shape and an average maximum cross-sectional dimension of no more than about 200 microns.

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17. The polymer substrate of claim 16 wherein the microfibers have an average length of no more than about 500 microns.

18. The polymer substrate of claim 16 wherein the microfibers have an
10 expanded-head shape.

19. A method of producing a unitary polymer substrate having a napped surface comprising:

laminating a surface of a thermoplastic polymer substrate to a
15 template surface formed of a release material, the template surface having a plurality of microdepressions; and

delaminating the thermoplastic polymer surface from the template surface while maintaining the thermoplastic polymer surface in a sufficiently softened state such that a plurality of microfibers are generated on the
20 thermoplastic polymer surface prior to debonding of the thermoplastic polymer surface from the template surface.

20. The method of claim 19 wherein the microfibers have an average length of about 50 to about 500 microns.

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21. The method of claim 20 wherein the microdepressions have an average depth of no more than about 40% of the average microfiber length.

22. The method of claim 19 wherein,
the laminating step comprises laminating the polymer surface to a resilient template surface comprising a plurality of undercut-shaped microdepressions; and
- 5 the delaminating step comprises delaminating the polymer surface from the resilient surface while maintaining the polymer surface in a sufficiently softened state to generate a plurality of expanded-cross section shaped microfibers projecting from the polymer surface.
- 10 23. The method of claim 22 wherein the resilient template surface comprises a polymer foam.
24. The method of claim 22 wherein the resilient template surface is formed from a silicone rubber.
- 15 25. The method of claim 24 wherein the template surface is formed from a silicone rubber film having a surface with a plurality of partial sphere shaped microdepressions therein.
- 20 26. The method of claim 19 wherein the template surface is formed of the release material includes a plurality of microdepressions each having a non-release surface therein,
the laminating step comprises laminating the polymer substrates to the template surface to form microprojections on the polymer substrates, each
25 microprojection being bonded to one of the microdepression non-release surfaces; and
the delaminating step comprises delaminating the polymer substrate from the template surface while maintaining the polymer substrate in a sufficiently softened state such that the microprojections are stretched into microfibers before
30 debonding from the non-release surfaces.

27. The method of claim 26 wherein the microfibers have an average maximum cross-sectional dimension of about 25 to about 200 microns.

28. The method of claim 26 wherein the microfibers have an average
5 length of about 50 to about 500 microns.

29. The method of claim 26 wherein the microfibers have a tapered cross-section.

10 30. The method of claim 29 wherein the microfibers have a curved profile.

31. The method of claim 26 wherein the template surface comprises a screen laminated to a surface of a non-release substrate, the screen having an outer
15 surface formed from a release material.

32. The method of claim 31 wherein the screen is formed from silicone rubber.

20 33. A unitary polymer substrate comprising a napped surface which includes a plurality of tapered microfibers, wherein the microfibers have an average maximum base cross sectional dimension of no more than about 200 microns.

34. The polymer substrate of claim 33 wherein the tapered microfibers
25 have an average maximum half height cross sectional dimension of no more than about 100 microns.

35. The polymer substrate of claim 33 wherein the tapered microfibers
30 have a length of no more than about 2,500 microns.

36. The polymer substrate of claim 33 wherein the microfibers have a curved profile.

37. A method of producing a unitary polymer substrate having a napped
5 surface comprising:

laminating first and second thermoplastic substrates separated by a release film having a plurality of holes therethrough such that the thermoplastic substrates are bonded together through microprojections extending from each of the substrates into the holes in the release film; and

10 delaminating the thermoplastic substrates while maintaining the thermoplastic microprojections in a sufficiently softened state to form first and second unitary polymer substrates having the microprojections stretched into microfibers prior to debonding of the thermoplastic substrates from each other.

15 38. The method of claim 37 wherein the release film is a silicone rubber screen.

39. The method of claim 38 wherein the release film is about 200 microns to about 1000 microns thick and the holes have an average maximum
20 cross-sectional area of no more than about 200 microns.

40. A method of producing unitary polymer substrates having a napped surface comprising:

laminating a carrier film to a first major surface of a non-porous
25 thermoplastic polymer film having a second major surface opposed to the first major surface; and

separating the second major surface from the carrier film while maintaining the thermoplastic polymer film in a sufficiently softened state to cause the thermoplastic polymer film to separate such that a portion of the polymer film
30 is drawn out into a plurality of high aspect ratio microfibers integral with and projecting from thermoplastic polymer remaining laminated to the carrier film.

41. A unitary polymer substrate comprising a napped surface which includes a plurality of high aspect ratio microfibers, each of said microfibers having a base integral with said napped surface and a free tip end, wherein said microfibers have a maximum cross-sectional dimension of no more than about 100
5 microns.